

## EGUN Studies of the Fermilab Preaccelerator – Part II

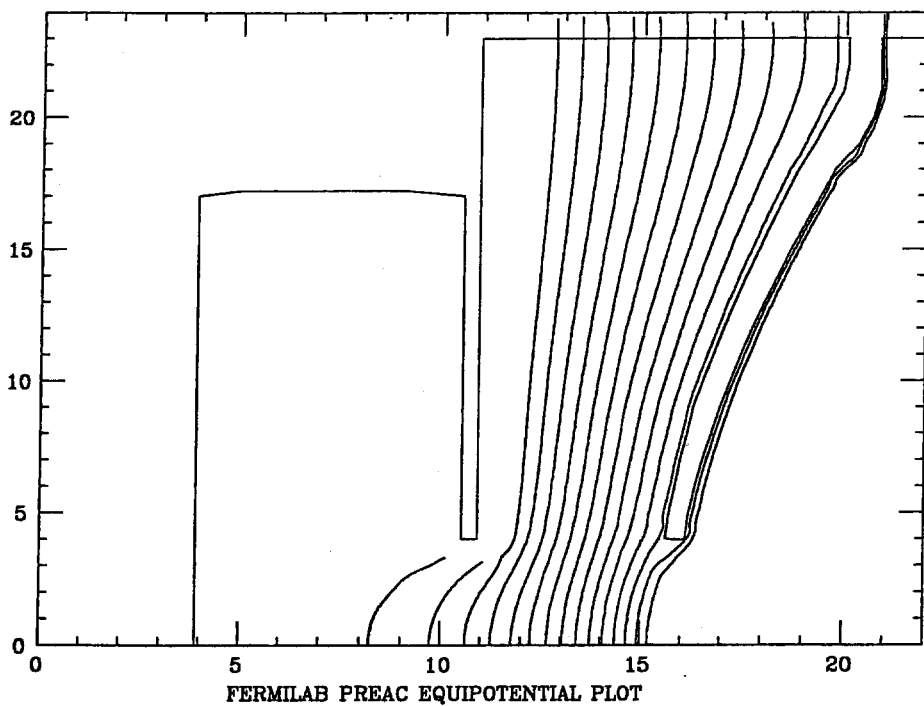
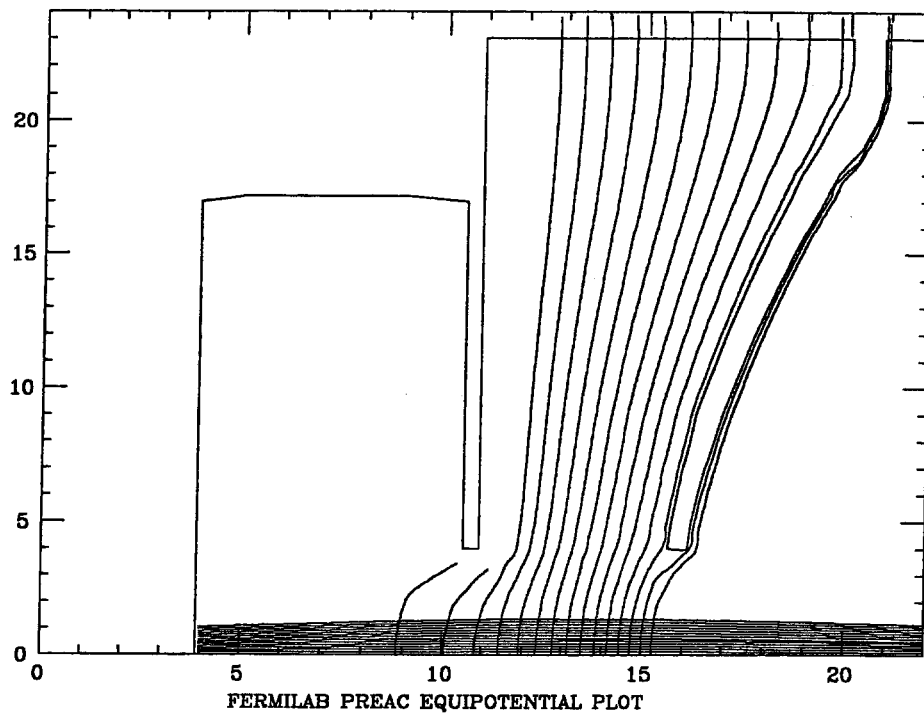
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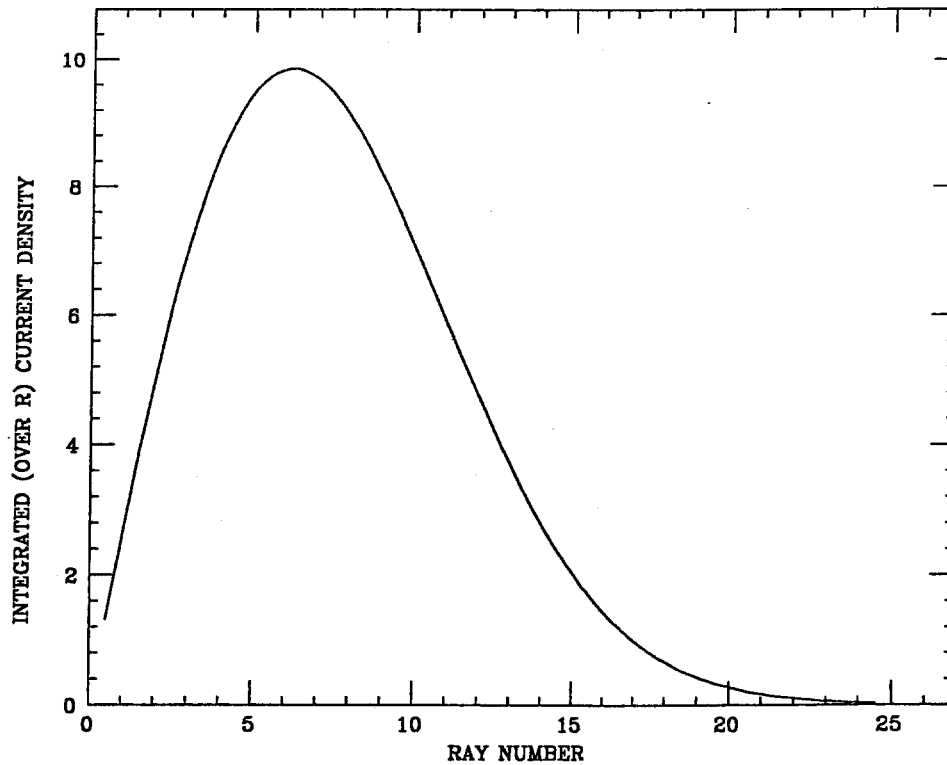
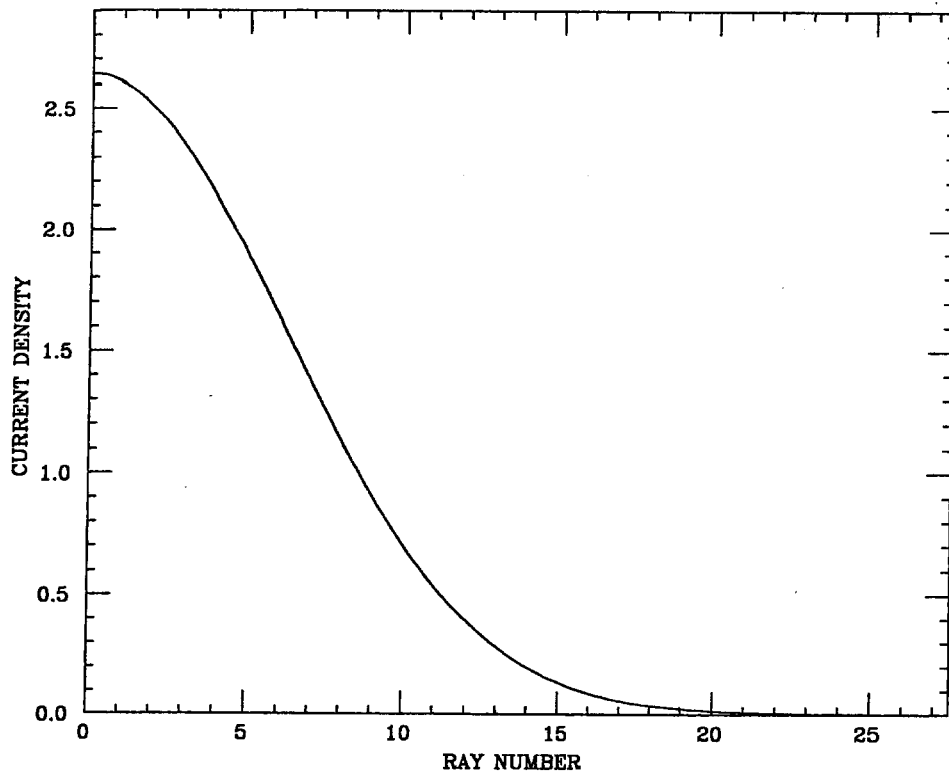
In my last report to the group, I discovered that I had made numerous erroneous assumptions in my initial EGUN study of the Fermilab Preac. This report contains results from recent EGUN calculations that were made under a more realistic set of assumptions. The first change (since the last report) is to include the focusing effect of the entrance aperture, and the defocusing effect of the exit aperture. The second correction was to use a potential of 25 kV on the first electrode (the first report used much too high a value). The third improvement is to use a more correct value for the beam temperature, although this may not be crucial for the EGUN studies. Lastly, this study includes gaussian as well as top-hat beam current distributions.

The results of the EGUN study are again presented graphically. I have made improvements in the graphics interfacing program which now allows more flexibility – a blowup of the electron ray tracing is now possible, providing a much clearer presentation of the results. The EGUN calculation indicates that the  $H^-$  beam is strongly focused by the preac. While the EGUN calculation does not indicate any emittance blowup of the beam for either the gaussian or top-hat current distributions, it is this authors opinion (possibly as erroneous as some of my earlier assumptions) that the strong focusing, in conjunction with the downstream linear focusing elements, may create emittance blowup due to the mismatch between the linear focusing and the nonlinear space charge defocusing. As was shown in my studies the first time, if the initial focusing of the entrance aperture is “turned off” the beam does not experience as strong a focusing. Thus, if a grid were to be placed over the entrance aperture less downstream focusing may be needed, with a possible improvement in emittance. (I have not done any grid survival studies.)

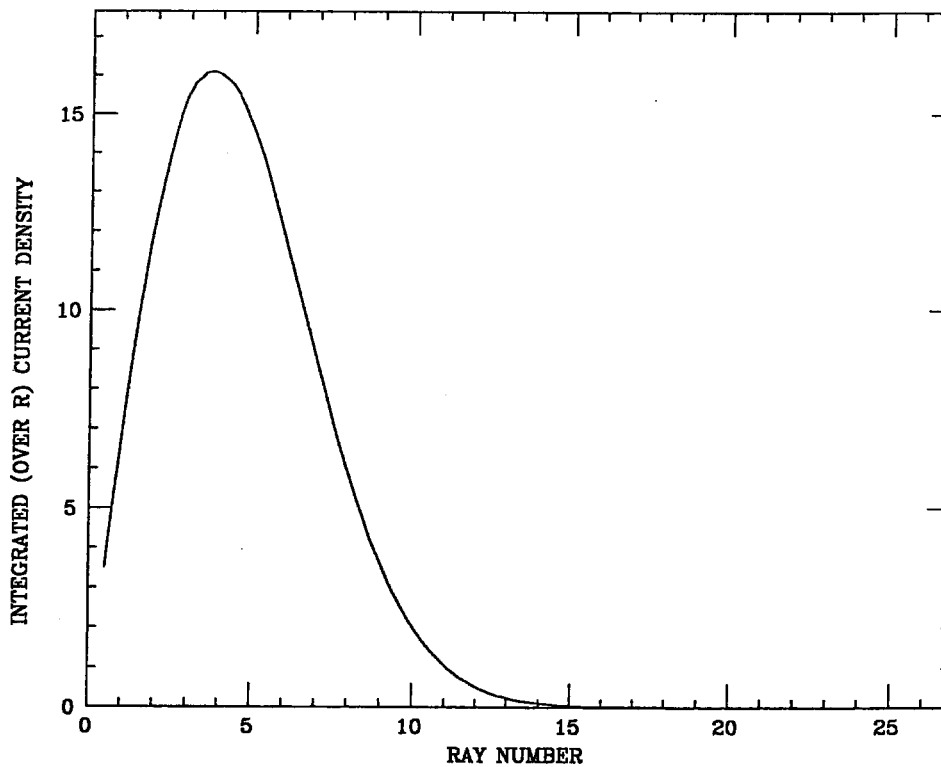
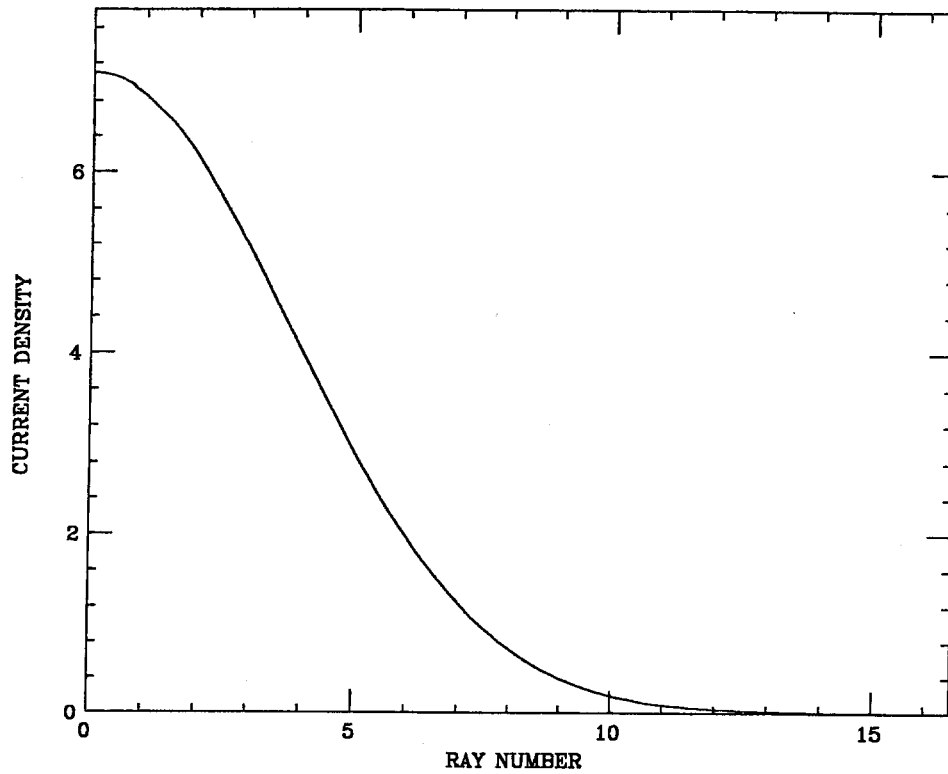
In addition to this report (handed out to members of the group) I have also prepared an additional document entitled "Supporting Documentation for the EGUN Study of the Fermilab Preaccelerator - Part II". This support document contains input files used for the EGUN analysis, the one readable output file generated by EGUN, as well as some EGUN studies done on the case where the voltage of the Preac is 200 kV. (As most of this may be of little interest to many members of the group, I have brought only a few copies of this support document.)



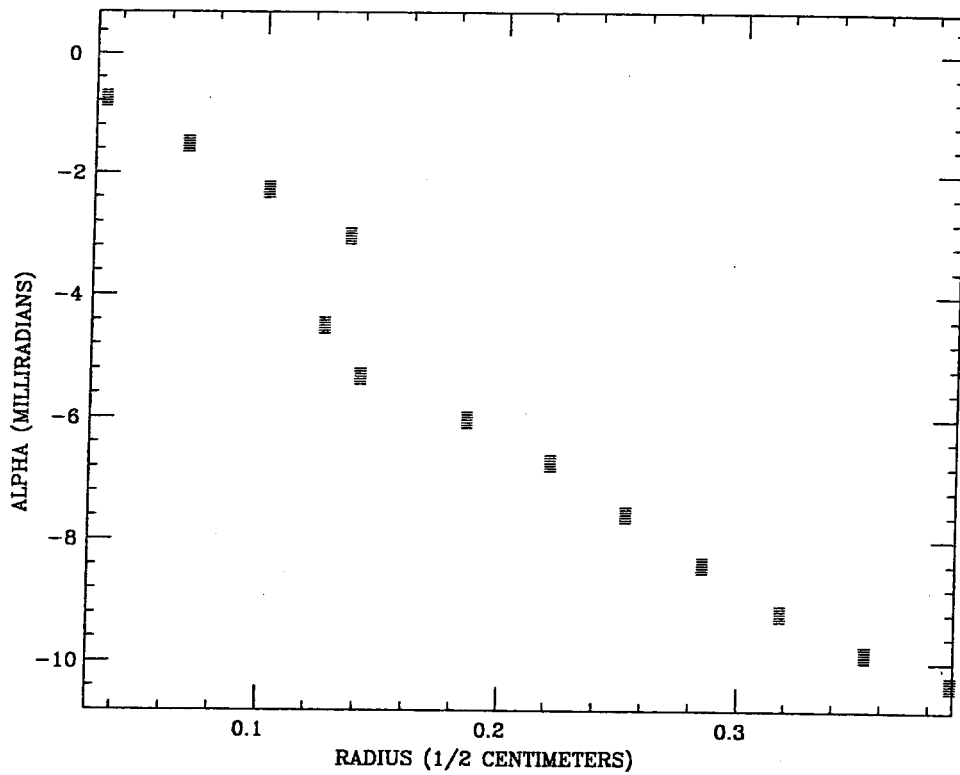
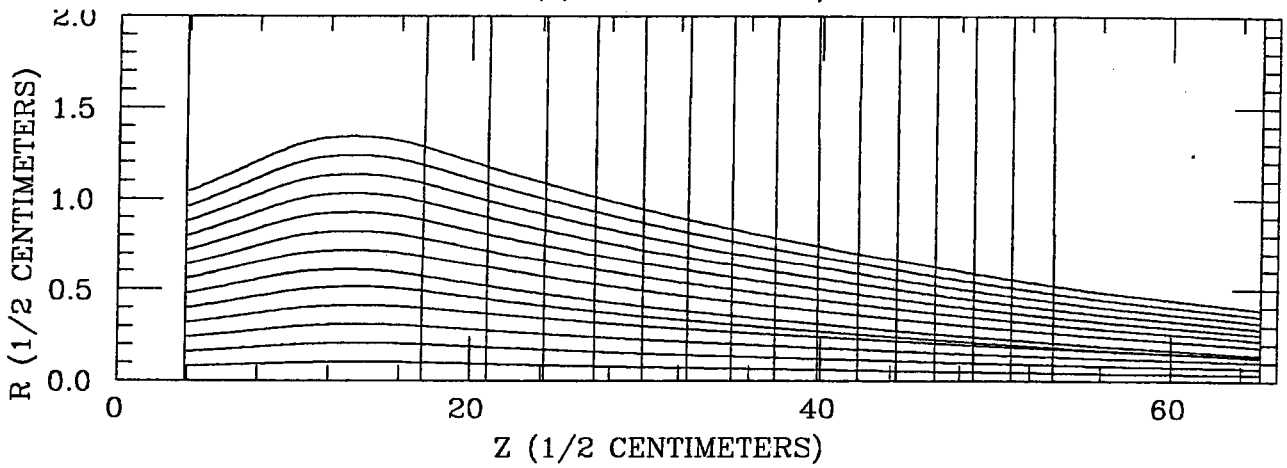
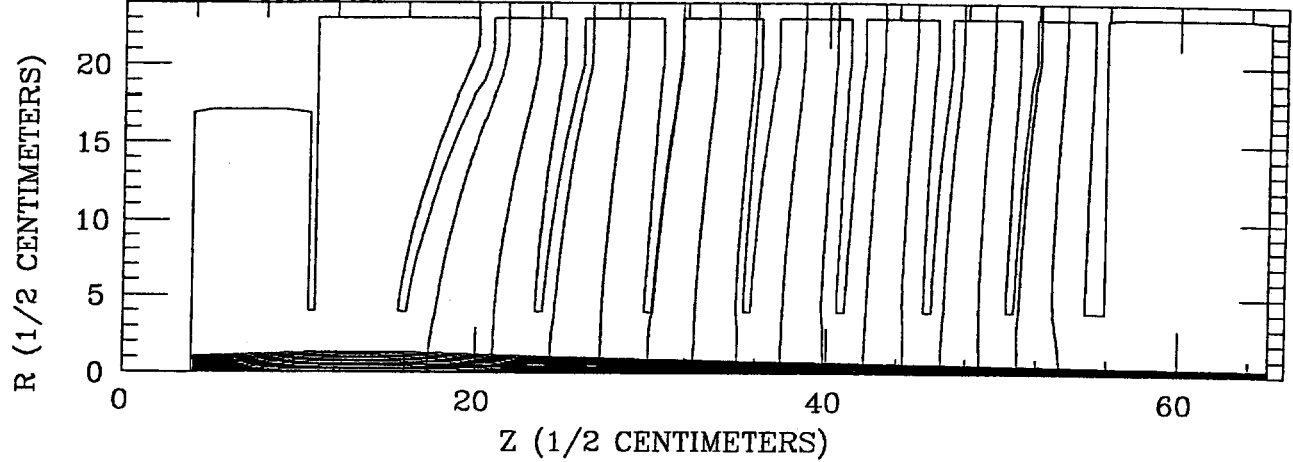
These figures show the equipotential lines formed by the electrodes at the entrance to the preac. The top figure includes the effect of the beam on the equipotentials. Note that the equipotentials indicate a residual inward radial field even in the presence of beam.



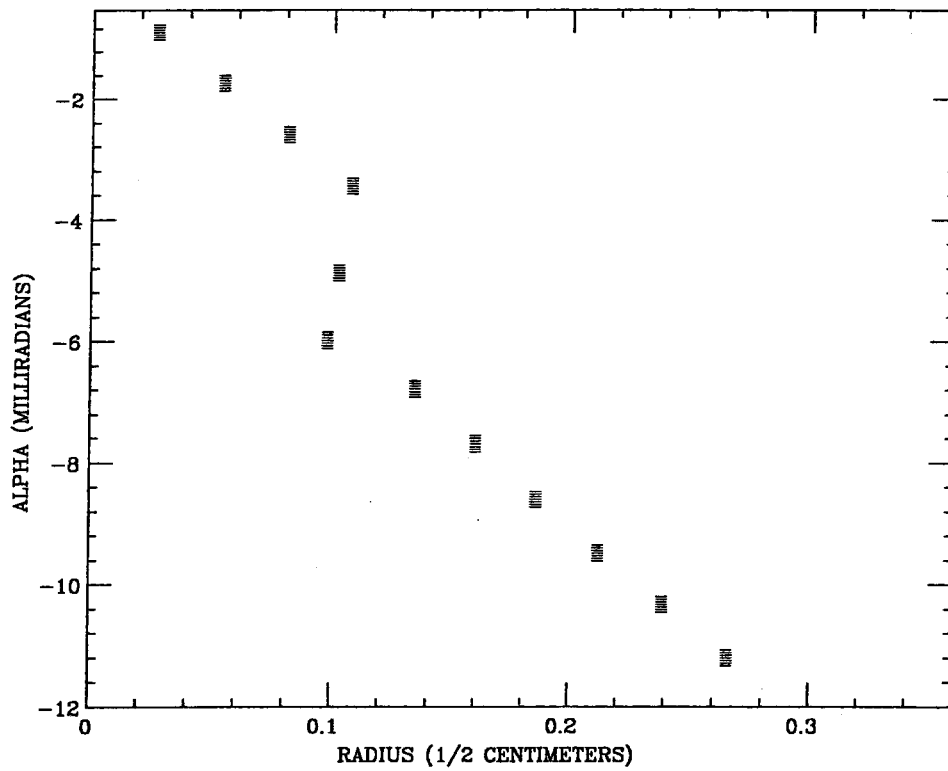
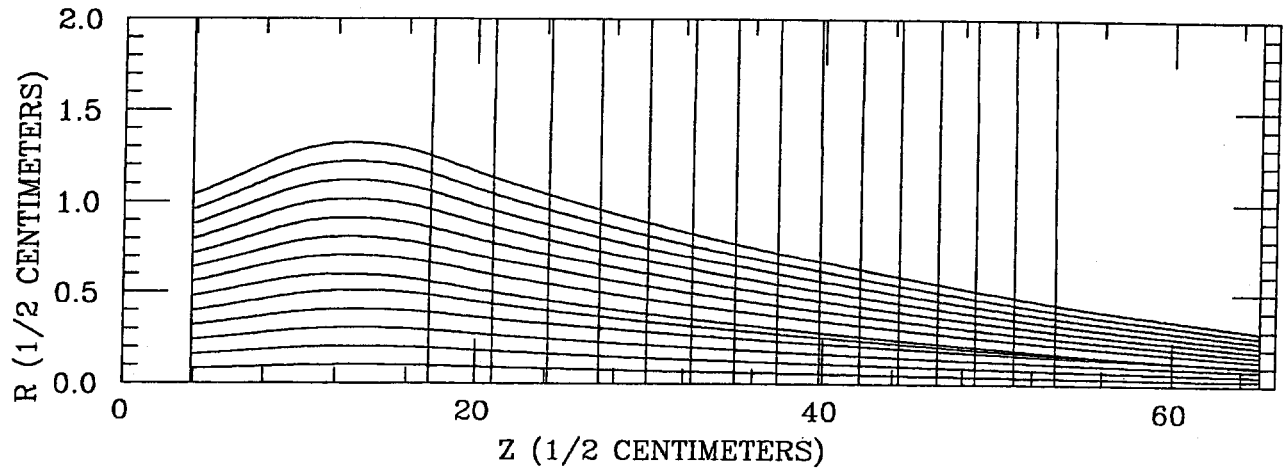
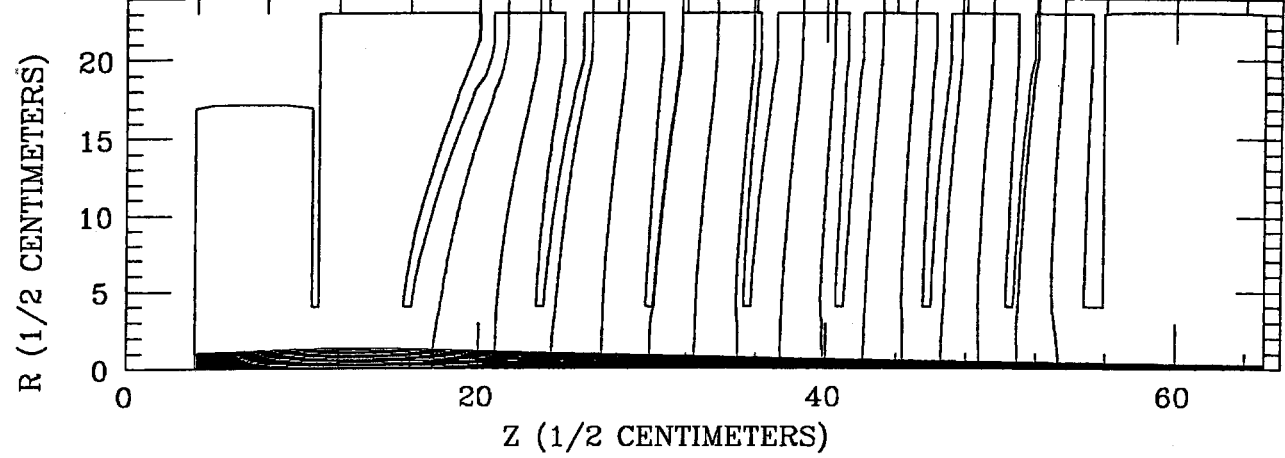
The top figure above shows the radial gaussian beam profile input to the EGUN program. The current represented by each ray is plotted in the lower figure. These plots are for 13 initial EGUN rays, corresponding to the studies done excluding emittance effects.



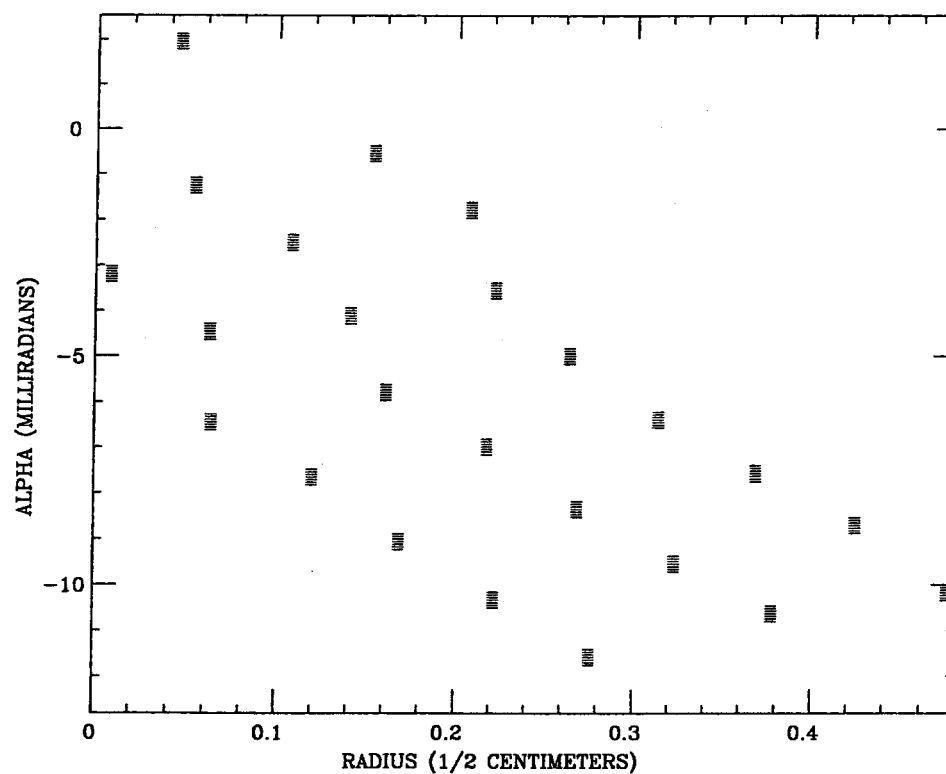
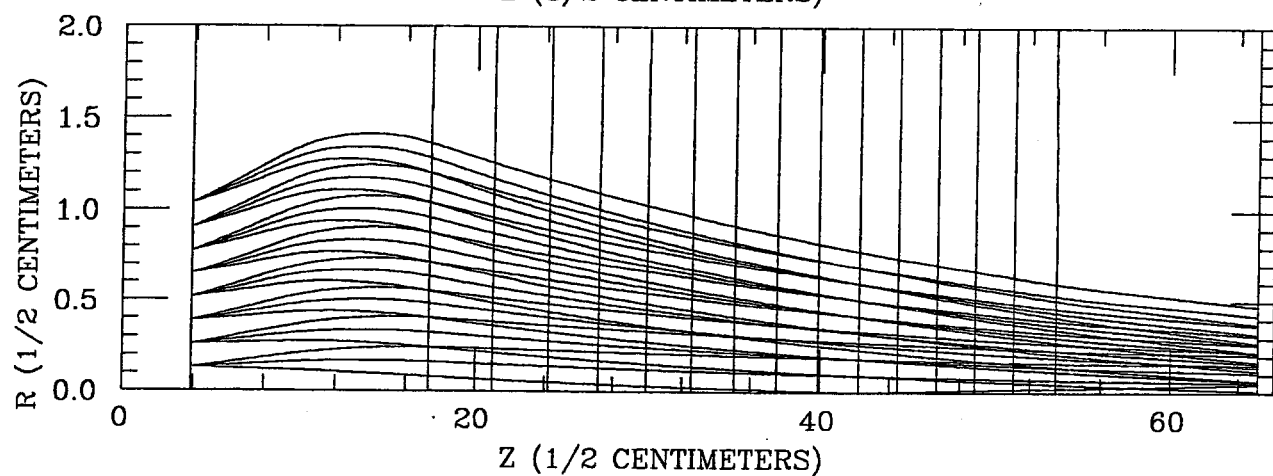
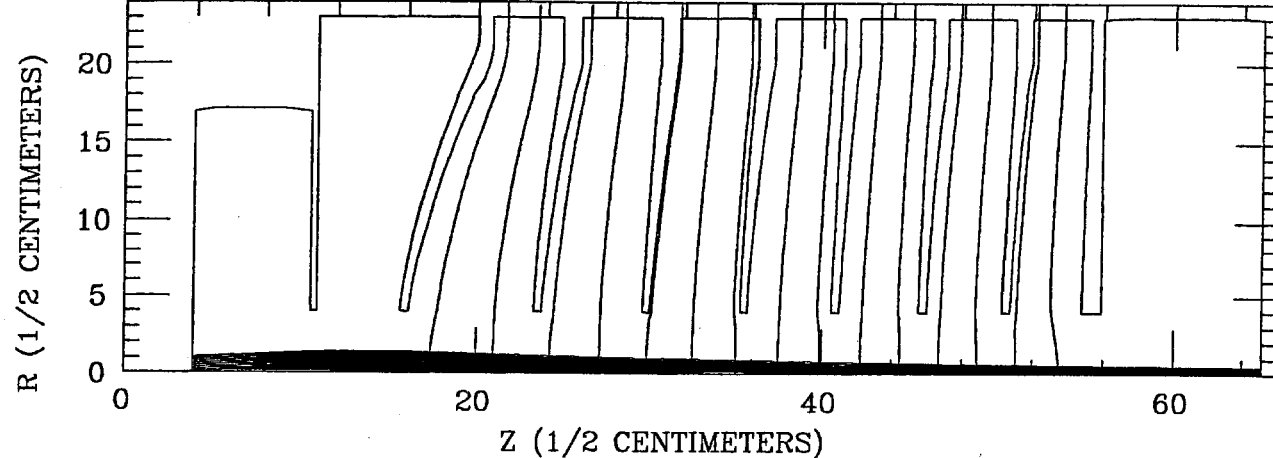
The top figure above shows the radial gaussian beam profile input to the EGUN program. The current represented by each ray is plotted in the lower figure. These plots are for 8 initial EGUN rays, corresponding to the studies done including emittance effects.



These figures show ray tracing for a top-hat radial beam current profile, excluding emittance effects. The preac voltage is 750 kV. The bottom figure is a phase space plot of the beam at the exit of the study, the middle figure is a blowup view of the trajectories.

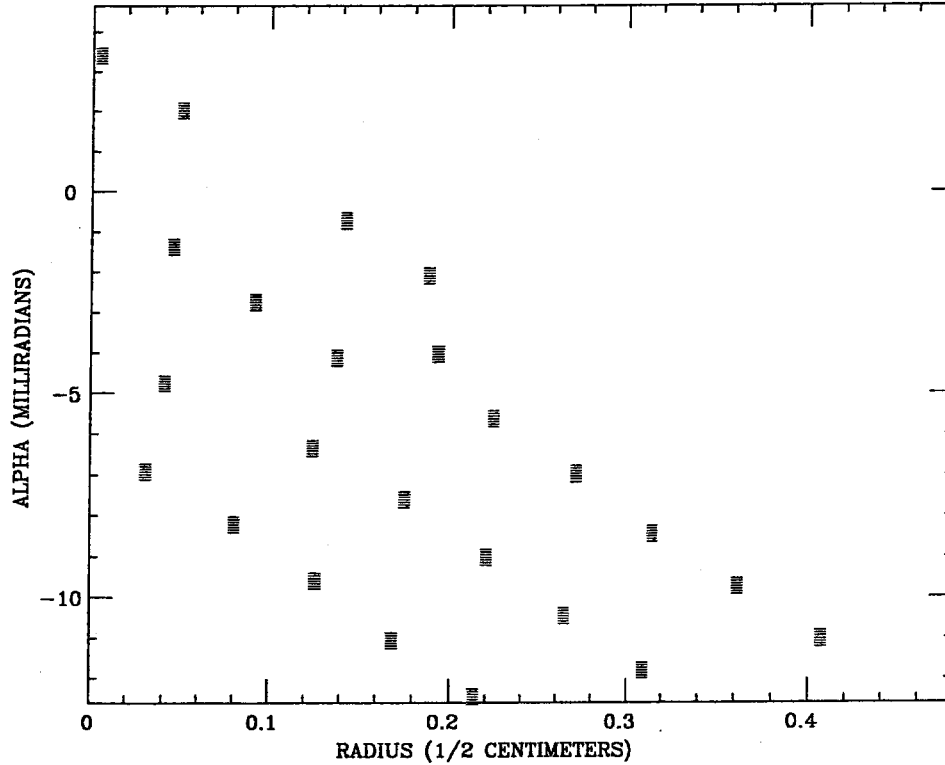
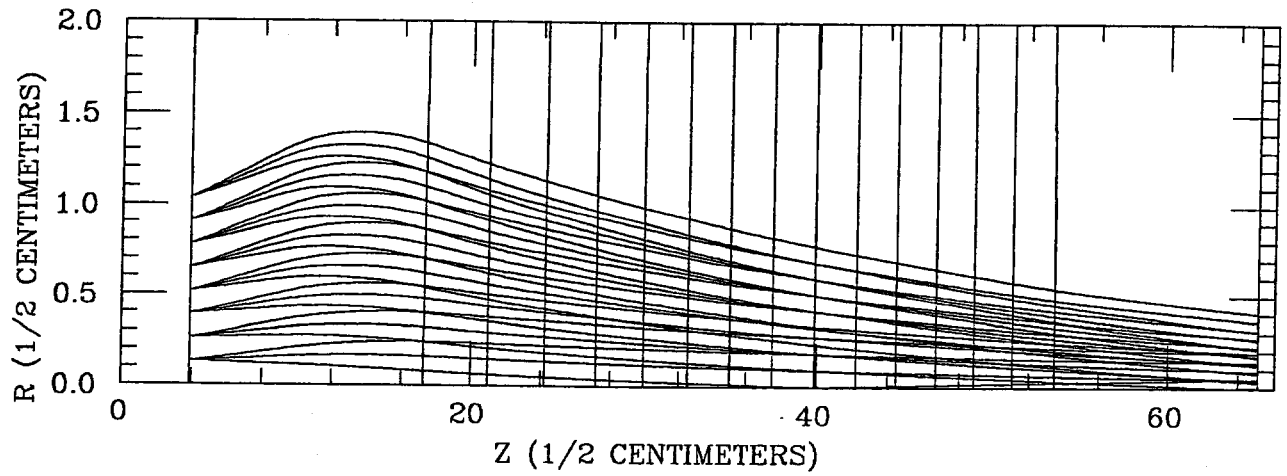
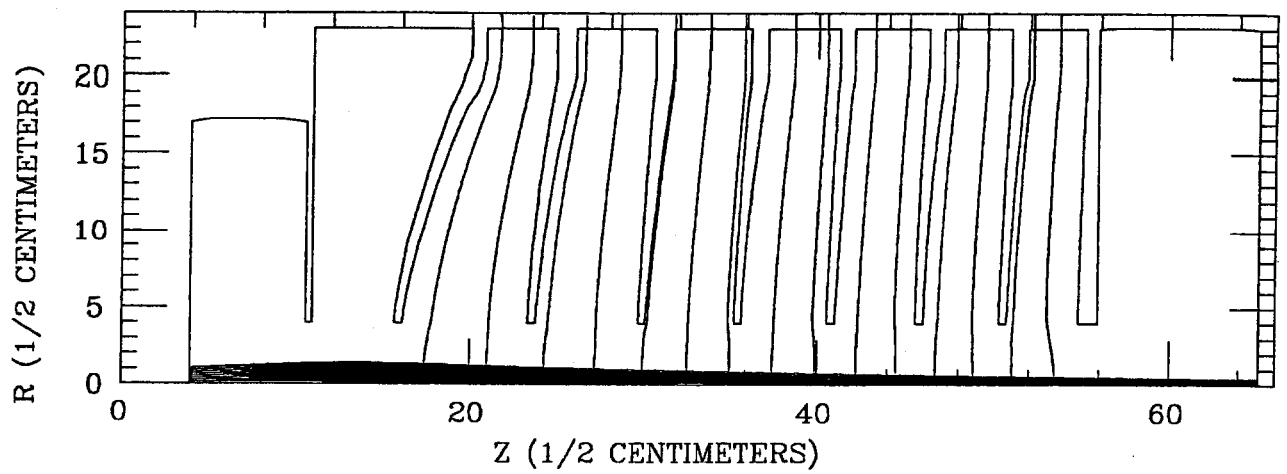


The top figure shows ray tracing for a gaussian radial beam current profile, excluding emittance effects. The preac voltage is 750 kV. The bottom figure is a phase space plot of the beam at the exit of the study, the middle figure is a blowup view of the trajectories.



These figures show ray tracing for a top-hat radial beam current profile, including emittance effects. The preac voltage is 750 kV. The bottom figure is a phase space plot of the beam at the exit of the study, the middle figure is a blowup view of the trajectories.





The top figure shows ray tracing for a gaussian radial beam current profile, including emittance effects. The preac voltage is 750 kV. The bottom figure is a phase space plot of the beam at the exit of the study, the middle figure is a blowup view of the trajectories.